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The Impact of Foreign Ownership on Innovation: Evidence from Emerging Markets

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Abstract

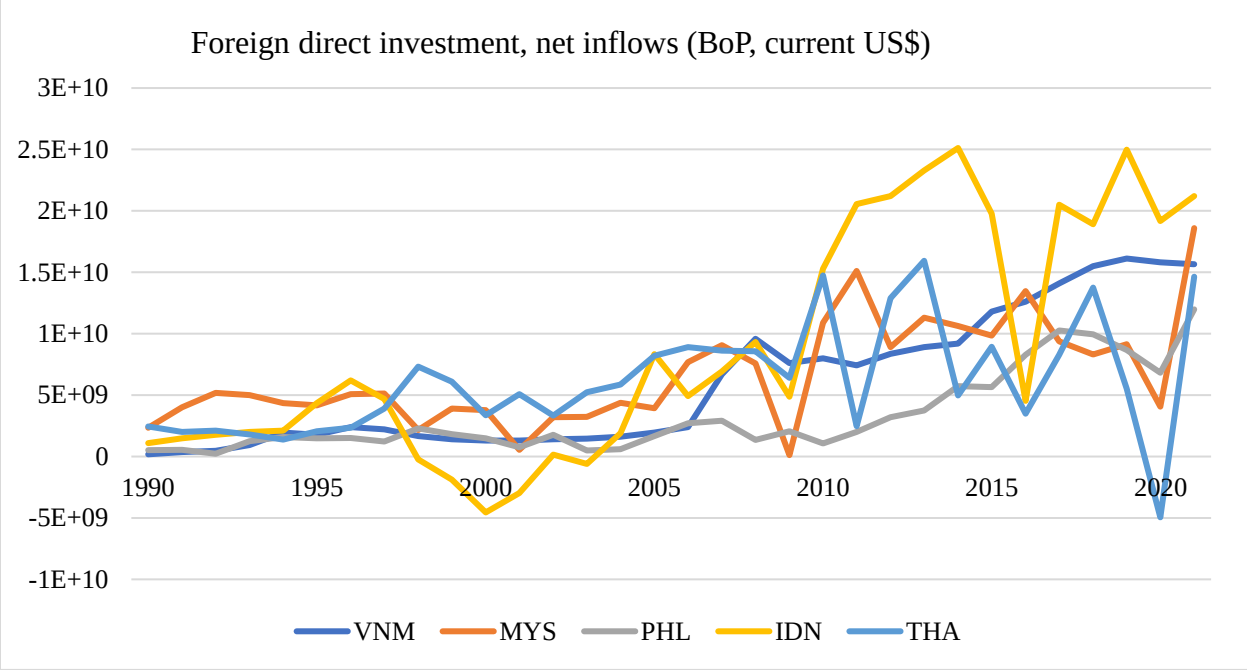
In this thesis, the goal is to analyze the influence of foreign ownership and foreign innovation spillover on firm innovation in five Southeast Asian emerging markets, namely Malaysia, Vietnam, Indonesia, Thailand, and the Philippines. As measures of innovation, process innovation and product innovation are used along with some other variables including R&D, patents and employee training. This study uses a logit regression analysis to analyze the connection between business ownership and the propensity for innovation. Logistic regression is used for analyzing binary outcomes such as innovation, which given the database used for this research have just two possible values, 0 for no innovation and 1 for innovation. The results thus can be interpreted probabilistically. The dataset used for this research contains a total of 5 651 observations taken from five countries. Regarding product innovation, the initial results indicated positive influence of foreign ownership on likelihood of innovation. However, the positive relationship fades when considering other factors and/or accounting for country-specific characteristics, suggesting that external factors may mediate the impact of foreign ownership. Besides that, while strong presence of foreign firms R&D activities in the regions seems to increase the likelihood of product innovation, foreign firm's product innovation spillover negatively affects the likelihood of product innovation, possibly due to increased competition. Regarding process innovation, the results once again indicate that significant and positive impact of foreign ownership on manufacturing process innovation, logistics process innovation and supporting activities innovation, fades when accounting for other factors. Moreover, in some models the results clearly indicate negative impact on foreign ownership. Regarding spillover effects, a significant positive impact of foreign firm's process innovation reginal spillover can be concluded. Finally, higher percentages of foreign ownership positively affect the likelihood of firms having R&D expenditure, performing employee training and registering patents.

Contents

1. Introduction

Emerging markets are becoming more and more important players in todays globalized economy, attracting notable attention from foreign investors. Innovation is among key drivers that impact the expansion and progress of developing economies. Firm innovation encourages economic competitiveness and productivity. As these markets keep evolving, well-informed decision-making and policy development gets more and more dependent on understanding the impact of foreign presence in emerging markets on firm innovation.

In this thesis the goal is to analyze the influence of foreign ownership and foreign innovation spillover on firm innovation in five Southeast Asian emerging markets, namely Malaysia, Vietnam, Indonesia, Thailand, and the Philippines. These nations experienced a rapid economic expansion, have an inviting business climate, and have drawn significant FDI over the years. This study's primary goal is to highlight the main factors driving innovation outcomes in these countries and the ways in which foreign presence can change the regional and sectoral innovation environment. Fluctuating nature of FDIs in these countries adds an element of unpredictability to the overall economic landscape compared to developed markets, which are usually analyzed in existing literature.



Source: World Bank. (n.d.).

In the previous literature the impact of foreign investments on firm innovation has been extensively analyzed. Guadalupe, Kuzmina, and Thomas (2012) find a positive correlation between foreign ownership and innovation, especially for firms that have lower initial productivity. In addition, previous literature has focused on spillover effects of foreign innovation. Baldwin, R., Braconier, H., & Forslid, R. (2005) find positive relationship between foreign investments and technological spillovers, indicating the significance of considering FDI in growth studies. Furthermore, studies like Javorcik's (2004) have developed specifications of spillover proxies which can be used for analyzing the impact of spillover effects on various measures of productivity, or in case of this analysis, on various measures of firm innovation. Finally, previous research has paid attention to distinguishing firms with majority and minority foreign ownership. Almeida, R., & Fernandes, A. M. (2008) find that companies with a majority of foreign ownership are notably less inclined to participate in technological advancements compared to firms owned either partially by foreigners or entirely by domestic entities. This observation can be interpreted as an indication that the technology shared from multinational parent firms to their majority-owned subsidiaries tends to be more established and less “cutting-edge” compared to what is passed on to minority-owned subsidiary firms. The database used in the analysis in this thesis gives access to firm level data such as share of firm owned by foreign investors, specific industries and regions firm operates in, and insights into ownership structure and firm productivity. Therefore, data is sufficient to analyze both, the impact of foreign investments on firm innovation and to estimate the innovation spillovers and their impact on firm innovation. Besides that, data gives opportunity to distinguish between majority foreign owned firms and firms with just any foreign owners, to provide further depth to the analysis.

The data chosen for the analysis is a set of Enterprise Surveys conducted by World Bank in 2015 (World Bank, 2023). The data provides important firm level insights into innovation indicators, ownership structure (portions of foreign, domestic, and governmental equity), and other relevant variables. Using the World Bank's Enterprise Surveys rather than other databases which provide access to firm level data like Eikon or ORBIS has a number of benefits. While other big datasets provide firm level information about large publicly traded corporations, the World Bank Enterprise Surveys include businesses of all shapes and sizes from various regions within one country. This large and diverse sample improves generalizability and representation.

This study uses a logit regression analysis to analyze the connection between business ownership and the propensity for innovation. Logistic regression is useful for analyzing binary outcomes such as innovation, which given the database used for this research have just two possible values, 0 for no innovation and 1 for innovation. The results thus can be interpreted probabilistically. In addition, logistic regression can handle

non-linear correlations, which is useful for studying the complicated relationship between foreign investment and innovation outcomes.

The study uses Javorcik's (2004) "Horizontal" specification of spillover proxy to examine the impact of innovation of foreign firms on domestic enterprises. This proxy is used to evaluate the impact of foreign enterprises on firms' innovation efforts by measuring the level of foreign involvement within specific industries and regions. These findings can provide insights on how to best encourage foreign investment and innovation in the home country by identifying the channels through which foreign presence benefits local business through an analysis of spillovers across industries and regions.

Taking into account both product and process innovation, the remaining chapters of this thesis go into the comprehensive results and analysis of the relationship between ownership structures and innovation outcomes. The study concludes that the presence of foreign ownership increases the probability of product innovation, possibly due to the greater access to financing and technology. However, this relationship is not always consistent, given various measures of innovation and factors employed in the analysis. Product innovation likelihood is boosted by government ownership, potentially because of the increased availability of funding and favorable monetary policies. In majority state-owned businesses, there is evidence of reduced innovation likelihood, potentially because of bureaucratic inefficiencies. When it comes to spillover effects, the presence of foreign enterprises can have both positive and negative effects, depending on the measures of innovation and spillover proxies employed to evaluate such benefits. Specifically, foreign R&D regional spillover tend to positively affect likelihood of product innovation, while foreign firm’s product innovation regional spillover negatively impacts likelihood of innovation in domestic firms. Further analysis which considers various measures of process innovation indicates similar results. Also, results indicate that foreign ownership positively impacts R&D activities, assumably inspiring domestic firms to invest in research to keep up with global standards. In addition, the foreign presence is positively correlated with likelihood of employee training and patent publications.

In conclusion, this study offers a thorough examination of the complex relationship between foreign ownership, foreign innovation spillover, and innovation outcomes in firms in Indonesia, Malaysia, Vietnam, Thailand, and the Philippines. Stakeholders can make better decisions to encourage innovation in these emerging markets if they have a firm grasp of these processes. While this research adds important context, more investigation is needed to determine how institutional variables and regulatory contexts affect the relationship between foreign ownership and innovation in specific sectors and regions.

The rest of the paper is structured as follows. Chapter 2 presents a review of existing literature on the topic. Chapter 3 describes the data used for the analysis. Chapter 4 explain the methodology of the analysis. Chapter 5 presents the main results and chapter 6 concludes.

2. Literature Review

There has been a lot of interest in the academic literature about how foreign ownership affects innovation within firms and how that innovation spreads to other enterprises within same region and sector. Several papers have looked into this relationship, each employing a unique approach and data. In this section, the focus is on the most important findings from several studies that address this topic.

According to Guadalupe, Kuzmina, and Thomas (2012), in the context of productivity, the correlation between innovation and foreign ownership differs across companies within industries. By utilizing the data from the Spanish Survey of Business Strategies and a partial equilibrium model, the authors found a positive correlation between foreign ownership and innovation, especially for firms that have lower initial productivity (Guadalupe et al., 2012). The authors utilize a popular approach called propensity score matching to deal with any potential selection bias caused by foreign investors picking companies with higher amounts of innovation. This methodology is widely spread in observational studies and is used to balance the attributes of non-acquired and foreign-acquired firms to make them comparable. This allows them to lower the odds of biased outcomes and strengthen the validity of casual interpretation of results. Propensity Score Matching is used to create a score of the probability of a company's ownership being acquired by foreign investors based on observable attributes. The attributes or characteristics in question can involve industry, company size, R&D expenditure, and more relevant variables. The authors pair each non-acquired and foreign-acquired company with similar propensity scores, ultimately establishing a control group. Propensity score matching is advantageous because it can simulate a randomized experiment in an observational setting. The authors are able to separate the effect of international acquisition on innovation from other possible causes by establishing a balanced control group. This methodology allowed them to make more valid conclusions about the cause-and-effect relationship between company innovation and foreign ownership.

Still, this methodology depends on panel or longitudinal data to keep track of changes in innovation and ownership structure over time. In case of this particular research, propensity score matching has limited application as only cross-sectional data for the year 2015 is available. Without ownership and innovation

dynamics, it is difficult to establish a cause-and-effect correlation between firm innovation and foreign ownership.

Luong, Moshirian, Nguyen, Tian, and Zhang (2017) look at how foreign institutional investors affect a company's propensity to innovate, as well as what drives that propensity. By utilizing firm-level data and country-level innovativeness measures, the authors find that institutional ownership from countries with high levels of innovation has a beneficial effect on business innovation, whereas ownership from countries with low levels of innovation has the opposite effect. The authors also discovered that foreign investors that come from countries with high innovation levels are keener to invest in companies with higher amounts of innovation production, which implies that they have the ability to identify companies' innovation levels and choose to support those with high levels.

The presence of foreign ownership within domestic companies comes with additional resources in the form of advanced technologies and financing, which creates an environment that promotes innovation. Foreign ownership also introduces insights into global markets and new perspectives, incentivizing domestic companies to innovate further, which allows them to retain competitiveness on a global scale. Additionally, considering that foreign investors have better tolerance towards risk, domestic firms can be encouraged to seek out innovative projects. The propensity to not avoid risk brought by foreign investors, can create an innovation-driven culture within a company. Moreover, foreign investors often offer substantial worldwide networks and experience, which may greatly improve inventive capacities via knowledge transfer and cooperation. Finally, there is already established empirical evidence from studies such as Luong, Moshirian, Nguyen, Tian, and Zhang (2017), or Guadalupe, Kuzmina, and Thomas (2012) that support this hypothesis, by utilizing strong methodologies which unravel a positive correlation between innovation and foreign ownership. These factors substantiate the following hypothesis.

H1. Share of foreign ownership is positively correlated with firm innovation

Among the mechanism which can potentially support H1, foreign investors may provide access to additional financial resources, enabling the firm to invest more in innovation. Furthermore, access to foreign capital, knowledge transfer and global networks which foreign investors provide can also foster innovation.

One of the factors regularly considered when analyzing impact of FDI on various firm characteristics and performance indicators is weather firm has a majority foreign ownership or not. In Fons-Rosen, C., Kalemli-Ozcan, S., Sørensen, B. E., Villegas-Sanchez, C., & Volosovych, V. (2021) authors take another look at the relationship between productivity of acquired firms and foreign ownership. The authors, first of all, compile a dataset at the level of individual firms for eight developed European nations, including details on domestic and international acquisitions and comprehensive balance sheet data from 1999-2012. Next, the authors

discuss the difficulty of isolating a single cause. To achieve this, the authors account for the effect of majority and minority acquisitions and compare them to domestic versus international acquisitions while also taking into consideration the influence of country and industry trends. They found that there is a moderate increase in productivity for companies acquired by foreign investors after four years, however, this is the case only for companies where foreign ownership has the majority stake. It should be noted that these results are driven by foreign investment rather than foreign divestment. Moreover, according to the findings of Almeida, R., & Fernandes, A. M. (2008), companies that are mostly foreign owned are less prone to engage in technological innovations as opposed to companies that have partial foreign ownership or are completely domestically owned. This finding suggests that the technology transferred from multinational parent corporations to their majority-owned subsidiaries is often more established and less innovative compared to what is transmitted to minority-owned subsidiary enterprises.

The conclusion we can draw from the findings of above researchers is a hypothesis that companies that are majority owned by foreign investors are less prone to innovation when compared to companies that have any amount of foreign ownership. This notion can be associated with the natural tendency of technology transfer and ownership structure within these firms, which are more prone to utilize stable and established procedures rather than making new innovations. Besides that, majority foreign owned firms might simply prioritize short term-term profits, rather than long-term investments in innovation.

H2. Firms with majority foreign owners innovate less than firms with just any percentage of foreign ownership

Spillover effects is another topic widely discussed in existing literature. Baldwin, R., Braconier, H., & Forslid, R. (2005) find positive relationship between FDI and technological spillovers, indicating the significance of considering FDI in growth studies and policymaking. Furthermore, studies like Javorcik's (2004) have developed specifications of spillover proxies which can be used for analyzing the impact of spillover effects on various measures of productivity, or in case of this analysis, on various measures of firm innovation. Liu, Lu, Filatotchev, Buck, and Wright (2010) examine the impact of knowledge spillovers and returnee entrepreneurs in regards to encouraging innovation in high-tech companies in growing economies, with a particular focus on China. They discovered that in contrast to non-returnee companies, returnee entrepreneurs possess knowledge-related advantages, which leads to increased innovation. Furthermore, outside sources of knowledge spillovers, like MNE employee mobility, and international human mobility, also contribute towards the performance of innovation in the context of high-tech companies (Liu et al., 2010). Gorodnichenko, Svejnar, and Terrell (2008) explore the correlation between innovation in growing markets and globalization, by utilizing data from 27 transition economies. According to the authors' findings, globalization positively impacts innovation, especially in terms of adopting to new

technologies. The authors note that supplying multinational corporations and participating in importing and exporting activities stimulate innovation among domestic businesses. Policies encouraging openness to trade and foreign investment can encourage creativity in emerging economies, and there is no supporting data that an inverted U relationship between innovation and competitiveness exists (Gorodnichenko et al., 2008). Together, these findings support the hypothesis that foreign innovation spillovers foster firm innovation.

H3. Foreign innovation spillover positively impacts firm innovation

Mechanism through which foreign innovation spillover can affect local firms' propensity to innovate can be knowledge diffusion and competitive pressure.

To summarize, the evidence shown in the literature review supports the claim that the level of firm innovation and foreign ownership have a positive correlation. Foreign ownership can increase innovation and productivity, particularly for less productive companies. In addition, policies that promote trade and foreign investment openness have been found to foster innovation in emerging markets. Firms with majority foreign owners tend to innovate less compared to those with more diverse ownership structure. Finally, foreign presence and innovation spillovers tend to positively impact firm innovation.

3. Data

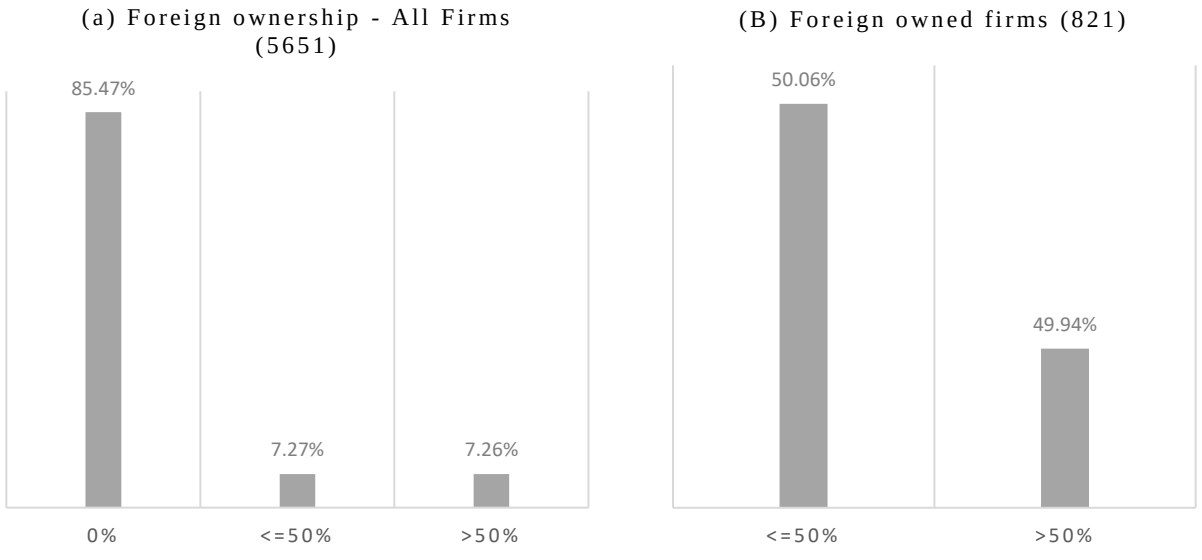
In this chapter, the applied cross-sectional data obtained from the World Bank Enterprise Surveys carried out in Indonesia, Malaysia, Philippines, Thailand, and Vietnam in 2015 will be extensively explained. The primary goal of the Enterprise Survey (ES) is to comprehend the views of the firms regarding the business environment and their experiences with the private sector. In the scope of firm innovation and foreign ownership, this information provides a useful perspective for the analysis of this thesis.

The purpose of the ES, which is a sustained program from the World Bank, is to collect factual information based on experiences of firms and their perspectives of the operating environment. At the moment, the ES collects data across 148 countries and more than 155 000 companies. 139 of those countries are examined with an optimized methodology. This improves the reliability of international and historical comparisons and aids in the development of globally comparable business environment indicators. In addition, the ES allows for the assembly of an enterprise data panel (but not the data needed for this research), which permits the monitoring of temporal shifts in the business environment and the foundation for effect evaluations of reforms (World Bank, 2023). There are several advantages for using the World Bank ES for this research. First of all, the data provided offers comprehensive data on the firm-level with abundant measures (which also includes different kinds of indicators for innovation), the ownership structure of the companies

(margins for domestic, foreign, governmental, and other types of owners), and data about the industry, size, and region of the companies. The comprehensiveness and abundance of data provides very useful insight into the impact of foreign ownership on the level of innovation of firms. Secondly, the ES' emphasis on growing markets, such as Indonesia, Malaysia, Philippines, Vietnam, and Thailand. This feature gives an advantage for ES over other databases such as Eikon or ORBIS, as these databases provide time series data but have limited information regarding their global scope, as they largely cover big, publicly traded firms or subsidiaries of large multinationals (Refinitiv, 2023 and Bureau van Dijk, 2023). The ES, on the other hand, is able to supply extensive data for a large sample of diverse companies representing a multitude of data for different industries, sizes, and regions. This extensive sampling improves the findings' generalizability and representation. Even though the ES has several advantages over other databases, it is also important to point out its shortcomings. For example, the cross-sectional structure of the data, which precludes estimation strategies that account for selection bias and other time-dependent factors, is a significant limitation. Due to such data limitations, causal judgments about the effect of foreign ownership on company innovation cannot be made. However, despite this shortcoming, the comprehensive, on firm-level data provided by the ES gives significant insight for this research. With proper corrections, such as controlling for potential confounding factors, and applying the correct econometric methods, the cross-sectional nature of the ES can still be utilized to generate notable and valuable results regarding the connection of foreign ownership on firm innovation.

The dataset used for this research contains a total of 5 651 observations taken from five countries. The observations used by country are Indonesia – 1320, Malaysia – 1000, Philippines – 1335, Vietnam – 996, and Thailand – 1000. The distribution of foreign owned firms across the database is presented in Figure 1. It can be observed that the vast majority of firms (85.47%) don't have any foreign investors while among the firms with foreign investors the number of majority (more than 50% of stake) and minority (less than 50%) foreign owned firms is almost identical.

Figure 1: Distribution of foreign ownership



4. Methodology

4.1 Estimation Strategy

To examine the correlation between innovation and foreign ownership some variations of the following equation are estimated.

(1)

$$Y_i = \alpha + \beta_1 FO_i + \beta_2 DO_i + \beta_3 GO_i + \beta_4 Horizontal_j + \beta_5 C + \varepsilon_{ijr}$$

Here, Y_i is a binary variable which indicates innovation output. As innovation output a number of different indicators and measures of innovation are used: Product Innovation, Product (Market) Innovation, Process Innovation (Manufacturing), Process Innovation (Logistics and Distribution) and Process Innovation (Supporting Activities). FO, DO and GO represent percentage of firm's equity owned by foreign, domestic and governmental investor. GO – gov ownership is used as alternative to FO factor that can potentially explain innovation outcomes. In previous literature, Zhou, K. Z., Gao, G. Y., & Zhao, H. (2017) show that governmental ownership in developing markets helps firms to obtain R&D resources but makes the firm less efficient in using those resources to create innovation.

Horizontal is a spillover proxy which measures the extent of foreign involvement in sector j. C represents the rest of the control variables which include Log Labor Productivity, Log Sales, R&D Dummy, Training and Patents. Detailed description of each variable used in equation (1) is presented in Appendix 1.

In addition, I examine if there is a correlation between firm innovation and majority foreign ownership particularly, using several variations of the following equation.

(2)

$$Y_i = \alpha + \beta_1 FO_i^{+} + \beta_2 FO_i^{maj.} + \beta_3 GO_i^{+} + \beta_4 GO_i^{maj.} + \beta_5 Horizontal_j + \beta_5 C + \varepsilon_{ijr}$$

Here, FO^{maj} (Foreign Ownership Majority) is a dummy variable which assumes the value of 1 if the company's majority ownership is allocated to foreign investors (50% or more of the ownership is from foreign investors). This allows to understand the effects on firms with majority foreign ownership in contrast to those with less foreign ownership. FO^{+} (Foreign Ownership Positive) is a dummy variable set to 1 if any margin of the firm's ownership is held by foreign investors, indicating that there is more than

0% of ownership held by foreign investors. This variable allows to examine the effect of any amount of foreign ownership present, regardless of its size. Similarly, GO^{maj} (Governmental Ownership Majority) - if the majority of the company is held by the government (50% or more), then the binary variable is assigned the value of 1. This metric allows to explore the effects on firms from majority government ownership. GO^{+} (Governmental Ownership Positive) - if the company has any margin of government ownership (more than 0%), this binary variable is set to 1. This variable gives insight into the influence caused by any size of government involvement. In previous literature, Zhou (2017) found that that a minority governmental ownership is an optimal structure for innovation development.

Taking into account that the dependent variable is a binary indicator, which shows if a given firm has engaged in innovation, it can be deduced that the logistic regression (logit) should be used. Logistic regression is used to determine binary outcomes and is convenient to use in situations where there are two possible outcomes. Logistic regression is a generalized linear model (GLM) used to estimate the likelihood of an event happening. This method allows us to estimate the correlation between the probability of innovation and the independent variable (shares of domestic, foreign, and government ownership). The primary benefit of logistic regression is its probabilistic interpretation of the results. Instead of estimating a direct correlation between the dependent and independent variable, logistic regression can examine the probability of a specific outcome, taking into account the values of certain independent variables. This feature is specifically useful when working with binary outcomes such as innovation, as it can provide a solid comprehension of the variables that influence the probability of innovation occurring. The non-linear connection between the independent variables and the likelihood of innovation is also accounted for by logistic regression. Logistic regression is able to capture the inherent relationship in a versatile manner, which allows potentially complicated interactions and nonlinear effects to be integrated into the analysis. The non-linear connection between the independent variables and the likelihood of innovation is also accounted for by logistic regression. Logistic regression is able to capture the inherent relationship in a versatile manner, which allows potentially complicated interactions and nonlinear effects to be integrated into the analysis. The findings from logistic regression may be understood and communicated as odds ratios or marginal effects, thus enhancing their usefulness. Through these measures, we can evaluate the significance of the odds of innovation occurring when the independent variables change (Hosmer & Lemeshow, 2000).

4.2 Spillover Channels

The spillover effect on innovations made by companies that have foreign investors can have considerable effects on domestic firms, thus, it is important to examine this phenomenon. Higher rates of innovation can be influenced by foreign investors who often introduce advanced technologies and extensive knowledge, which can be distributed to local companies through various means. Understanding these spillovers will allows policymakers and researchers to develop methods of attracting foreign investment, which leads to development and higher competitiveness among the local companies. Moreover, foreign investors can influence domestic companies to learn from them and develop their capabilities, allowing them to become competitive in the global market. Consequently, understanding the effects of information diffusion on local business productivity and longevity is made clearer by studying innovation spillovers from foreign investors.

To estimate the innovation spillover effect across sector j I use Javorcik (2004) specification of spillover proxy *Horizontal* which measures the extent of foreign involvement in sector j and can be defined as,

(3)

$$Horizontal_j = \left[\sum_{i\ for\ all\ i \in j} FO_i * Y_i \right] / \sum_{i\ for\ all\ i \in j} Y_i$$

where, FO is a percentage of foreign ownership in firm i and Y is and indicator of innovation. Hence, *Horizontal*'s value rises in tandem with both the innovation output of foreign investment enterprises and the proportion of foreign ownership within these firms. In addition to estimation of spillover across sectors I also estimate spillover effect across regions using similar specification.

5. Main Results

5.1 Descriptive statistics and spillover channels estimation

Table 1 presents descriptive statistics for the main variables used in further analysis. DO variable which is a percentage of firm owned by domestic investor has a mean of 0.862, suggesting that, on average, companies in the dataset have a high percentage of domestic ownership. The relatively low standard deviation (SD) of 0.303 indicates that there is not much variation in domestic ownership percentages among the observed firms. The values range from 0 to 1 indicates that domestic ownership can vary from 0% to

100%. In case of FO which is a percentage of foreign ownership, mean of 0.083 suggests that, on average, companies have a relatively lower share of foreign ownership. The SD of 0.244 suggests greater variability in foreign ownership percentages compared to domestic ownership. GO variable which is a percentage of state ownership has a very low mean of 0.006, indicating that, on average, companies in the dataset have a minimal percentage of governmental ownership. However, the relatively higher SD of 0.055 indicates some variability in governmental ownership percentages.

In case of FO^{Maj}, the binary variable indicates whether a company has a majority foreign ownership (50% or more). The mean of 0.073 suggests that a small proportion of firms have majority foreign ownership. On the other hand, FO^{+}, which indicates whether a company has any foreign ownership, regardless of the percentage has a mean of 0.145 indicating that a larger share of firms in the dataset have some level of foreign ownership. Finally, mean of 0.011 for GO^{Maj} suggests that only a very small proportion of companies have majority government ownership. Similarly, GO^{+} mean of 0.023 suggests that a small proportion of companies in the dataset have some degree of government ownership.

Companies typically have higher engagement in process innovation for manufacturing and supporting activities (means of 0.245 and 0.254 respectively), and lower engagement in R&D (mean=0.147), patents (0.107) and product (market) innovation. Log Labor productivity ranges from 0.517 to 8.057, and log sales range from 2.521 to 9.701.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
DO	5614	0.862	0.303	0	1
FO	5614	0.083	0.244	0	1
GO	5615	0.006	0.055	0	0.99
FO^{Maj}	5651	0.073	0.259	0	1
FO^{+}	5651	0.145	0.352	0	1
GO^{Maj}	5651	0.011	0.103	0	1
GO^{+}	5651	0.023	0.149	0	1
Product Innovation	5522	0.206	0.404	0	1
Product (Market) Innov.	5651	0.132	0.338	0	1
Process In. (Manufacturing)	5530	0.245	0.43	0	1
Process In. (Logistics & distribution)	5496	0.205	0.404	0	1
Process In. (Supporting activities)	5550	0.254	0.435	0	1
RD Dummy	5534	0.147	0.355	0	1
Training	5585	0.268	0.443	0	1
Patent	5526	0.107	0.309	0	1
Log Labor Productivity	5412	4.09	0.794	0.517	8.057
Log Sales	5446	5.679	1.046	2.521	9.701

Detailed variable description is presented in appendix 1.

Table 2, panel A presents the results of spillover effect estimation across sectors. Three different variables are used as indicators of innovation *Y*, indicators of product innovation, process innovation and R&D dummy. Thus, Table 2 presents three different estimators of spillover effect, each based on different measure of innovation. Horizontal (Product - Sector) is a variable captures the sectoral spillover effect of product innovation by foreign firms. It analyzes the impact of foreign firms' innovations in specific industries on the sector as a whole. Horizontal (Process - Sector) captures the sectoral spillover effect of process innovation by foreign firms. It analyzes the impact of foreign firms' innovations in specific industries on the sector as a whole. Horizontal (R&D - Sector) concentrates on the sectoral spillover effect of foreign firms' R&D activities. It examines the impact of R&D investments in certain sectors and industries.

The greatest value from Horizontal (Product) is electronics at 41.81, which implies a high rate of outside innovation in that sector in contrast to others. Likewise, the numbers for Horizontal (R&D) and Horizontal (Process) are relatively high as well. These results illustrate that firms with foreign ownership in the electronics industry contribute a significant margin to the innovation in the region overall. A substantial presence in terms of foreign innovation in the industry of recycling is indicated by a high value of 33.33 in both Horizontal (Product) and Horizontal (Process). Horizontal (Product) and Horizontal (Process) have relatively lower values (at 22.04 and 21.31 respectively) for plastic and rubber in Southern Asia countries. Paper, Publishing, Printing, Recorded media, and Tobacco are some of the industries where no values were recorded.

Table 2, panel B presents the results of spillover effect estimation across regions. Horizontal (Product – Region) measures the regional spillover effect of foreign firms' product innovation. Its value rises proportionally to both the innovation output of firms with foreign investment and the proportion of foreign ownership in these firms. Horizontal (Process – Region) measures the regional spillover effect of foreign firms' process innovation. Its value rises proportionally to both the innovation output of firms with foreign investment and the proportion of foreign ownership in these firms. Horizontal (R&D - Region) examines the regional spillover effect of foreign firms' R&D activities. It examines the effects of R&D investments in certain regions on neighboring regions.

In terms of presence of foreign innovation in capital cities, it would appear that the Philippines' Metro Manila and Indonesia's DKI Jakarta show an average amount. This presence could be associated with the concentration of economic activities, infrastructure, and government institution in capital cities. Such elements provide a good basis for promoting innovation, as they grant better access to markets, skilled labor, and resources, which ultimately contributes to attracting foreign investment. As mentioned before, multiple established elements contribute to attracting foreign investment. Regions such as Malaysia's Central region and Philippines' Calabarzon are economically significant – they have established supply

chains, advanced infrastructure, and skilled workforce. These elements allow such regions to serves as major industrial and commercial hubs, which serves to attract foreign investment. Thus, they demonstrate a high presence of foreign investment. Some regions (ex. Indonesia's Jawa Barat or Thailand's North) may exhibit higher levels of Horizontal (R&D), which may be attributed to factors such as presence of universities, research institutions, or favorable government policies.

Table 2: Extent of foreign innovation presence across sectors and regions

Panel A: Sectors

	All Firms	Domestic Firms	Firms with foreign owner	Horizontal (Product)	Horizontal (Process)	Horizontal (R&D)
Electronics	296	181	106	41.81	34.06	33.39
Recycling	24	20	2	33.33	33.33	-
Precision instruments	13	6	7	29.67	29.67	49.67
Plastics & rubber	498	373	102	22.04	21.31	28.41
Chemicals	354	251	72	15.49	17.25	13.71
Wholesale	300	249	29	14.31	6.77	14.25
Fabricated metal products	325	245	70	9.47	13.55	14.72
Machinery and equipment	104	78	24	9.13	13.33	20.83
Food	780	618	81	8.13	5.96	12.37
Garments	676	565	92	6.93	6.64	12.23
Nonmetallic mineral products	339	265	44	6.73	8.49	11.66
Basic metals	80	53	20	6.23	7.33	4.64
Transport	67	62	5	6.15	4.21	5.44
Furniture	83	63	12	4.76	5.56	23.33
Retail	629	533	41	4.30	3.77	6.58
Construction	211	184	11	3.70	2.00	-
Textiles	177	155	14	2.83	3.43	5.00
Leather	78	57	18	2.78	7.86	17.00
Services of motor vehicles	143	126	2	2.31	2.00	10.00
Hotel and restaurants	128	106	13	2.24	1.86	2.50
Wood	68	56	3	1.47	6.94	3.13
Paper	30	24	4	-	15.00	-
Publishing, printing, and Recorded media	80	71	3	-	5.19	3.33
Transport machines	24	15	9	-	25.00	10.00
Tobacco	5	5	0	-	-	-
Refined petroleum product	9	6	2	-	10.00	10.00
IT	24	20	2	-	-	-

Table 2: Extent of foreign innovation presence across sectors and regions

Panel B: Regions

	All Firms	Domestic firms	Firms with foreign investor	Horizontal (Product)	Horizontal (Process)	Horizontal (R&D)
Indonesia, Lampung	96	87	6	55.50	16.67	50.00
Philippines, Calabarzon	227	142	84	32.59	31.32	33.34
Malaysia, Central	291	218	58	25.61	17.25	22.65
Indonesia, DKI Jakarta	175	124	44	21.58	23.03	23.71
Philippines, NCR excluding Manila	457	364	93	16.96	13.59	17.50
Indonesia, Banten	149	86	29	14.89	15.79	16.55
Thailand, Central	326	285	41	14.85	11.31	15.73
Philippines, Central Luzon	256	206	47	13.74	16.87	16.51
Philippines, Metro Cebu	201	146	55	13.41	16.27	5.56
Malaysia, South	209	124	56	10.95	7.25	3.93
Thailand, North	131	118	13	9.42	7.65	23.22
Vietnam, South East	339	274	50	9.31	6.19	14.95
Philippines, Metro Manila	194	166	28	8.35	10.28	13.37
Vietnam, Mekong River Delta	145	133	11	6.85	8.68	7.64
Malaysia, East Coast	153	102	20	5.56	3.33	4.00
Malaysia, North	204	128	40	5.00	10.19	10.81
Indonesia, Jawa Barat	201	167	30	4.93	7.75	34.40
Vietnam, North Central area and Central coastal area	210	187	12	4.88	4.07	4.68
Indonesia, Sulawesi Selatan	95	90	3	3.33	1.54	-
Vietnam, Red River Delta	302	269	17	2.30	2.58	7.19
Thailand, South	126	90	33	1.67	4.26	2.50
Indonesia, Jawa Timur	218	203	8	0.91	-	-
Indonesia, Bali	97	89	5	-	4.44	8.00
Indonesia, Jawa Tengah	191	171	5	-	-	-
Indonesia, Sumatera Utara	98	48	8	-	7.69	-
Malaysia, East Malaysia	143	38	9	-	3.18	2.00
Thailand, Bangkok	274	264	10	-	-	-
Thailand, Northeast	143	137	6	-	-	-

5.2 Product Innovation

Table 3 presents the results of a logit regression with product innovation being the dependent variable. Product Innovation is a dummy variable equal 1 in case if the company has implemented new or substantially improved products or services in the past three years. If not, then this value is set to 0. This variable allows to evaluate the extent to which firms innovate their products during the specified time period. Panel A shows the results of estimating equation (1) with FO, GO and DO being percentages of foreign, governmental and domestic ownership respectively. Panel B in turn presents the results obtained using equation (2) with binary variables FO^{maj}, FO^{+}, GO^{maj} and GO^{+}. FO^{maj} is a dummy variable which assumes the value of 1 if the company's majority ownership is allocated to foreign investors (50% or more of the ownership is from foreign investors). FO^{+} is a dummy variable set to 1 if any margin of the firm's ownership is held by foreign investors, indicating that there is more than 0% of ownership held by foreign investors. GO^{maj} is a dummy equal 1 if the majority of the company is held by the government (50% or more). GO^{+} equals 1 if the company has any margin of government ownership (more than 0%).

Going further tables 4, 5, 6, 7, 8, 9 and 10 follow similar division into panels A and B representing results of equation (1) and (2) estimation respectively. In all tables, results of logistic regressions are presented as odds ratios, with $OR = \exp(\beta)$.

From Table 3, Panel A we can observe the following results. In column 1, for the independent variable FO statistically significant odds ratio of 1.78 represents the change in odds of a firm having a product innovation for a one-unit change in the percentage of foreign ownership. In the context of logit regression, "odds" are the likelihood of an event occurring. In case of table 3, the event is a firm having a product innovation (1), and the non-event is a firm not having a product innovation (0). With an OR of 1.78, for each one-unit increase in the FO, the odds of a firm having a product innovation are 1.78 times higher compared to the odds for a one-unit decrease in the % of foreign ownership. In other words, when the FO goes up by one unit, the odds of having a product innovation increase by a factor of 1.78. If FO goes down by one unit, the odds of having a product innovation decrease by a factor of $1/1.78$ (≈ 0.56).

Furthermore, column 2 introduces FO and GO to the logit regression as independent variables. The statistically significant positive correlation of foreign ownership to product innovation probability remains robust with OR of 2.616. However, we can also observe significant and quite substantial odds ratio of 9.294 of governmental ownership. When state's share goes up by one unit, the odds of having a product innovation increase by a factor of 9.294. One possible explanation for this is that governments often have access to significant financial resources, enabling gov-owned firms to invest in research and development initiatives that private firms in emerging markets might find risky. This assumption is also supported by results of

table 8 which indicates strong positive correlation between governmental ownership and R&D activities in firms. Other explanations are that firms that are state-owned can prioritize long-term strategic objectives over short-term profits, allowing them to focus on innovation without immediate market pressures. Also, state ownership can provide policy support and creating a favorable environment for firms to innovate.

Columns 3 and 4 introduce additional control variables Log Labor Productivity, Log Sales, R&D Dummy, Training and Patents. In column 3 we can observe OR of FO remains above 1 (1.277) although not significant. It's possible that these new variables are explaining more of the variance in the outcome variable, making foreign ownership's effect less apparent. On the other hand, governmental ownership remained its positive statistically significant correlation with product innovation likelihood, with OR (5.307) being slightly lower than in column 2. Going further GO remains robust across all models, in case of both, OLS and Logit specifications.

The OR for log labor productivity, R&D dummy, training and patent are all significant and above 1. R&D and training have the largest effect among control variables when considering both, OR and OLS coefficients. Increased productivity may indicate that firms are more able to innovate as a result of their use of resources. Investments in education and training have a favorable effect on inventive capacities, and patents are a symbol of the protection and acknowledgement of innovative results. When taken as a whole, these elements help foster new product development. Furthermore, results of column 3 remain robust in column 4 with OLS coefficients for log labor productivity, R&D dummy, training and patent being all positive and statistically significant.

Columns 5, 6 and 7 introduces variables estimating the spillover effects. In column 5, significant OR of 0.016 and 0.1 for Horizontal (Product - Region) and Horizontal (Product - Sector) respectively indicate that one-unit increase in the foreign innovation spillover effect across regions and sectors, while holding all other variables constant, the odds of a firm having a product innovation decrease substantially. This may be due to the market domination of foreign companies, which has decreased the incentives for domestic companies to develop because they may face fierce competition. The potential reason behind such tradeoff is that foreign firms might bring advanced equipment and resources to the industry, which can disrupt the innovational process of the local firms. On the other hand, OR for Horizontal (R&D - Region) and Horizontal (R&D - Sector) are 49.913 and 12.922 respectively. This could be a result of foreign companies' R&D financial contributions and achievements spillover, which benefit the sector as a whole, promoting technological progress and innovation. Research and development efforts made by foreign companies in a particular region have positive spillover effects on companies in these regions. One possible explanation is the spread of knowledge, which allows regions to reap the benefits of one another's technical progress via the movement of qualified workers and information sharing.

Finally, Column 6 shows similar results when the equation (1) is run using OLS. On the other hand, when accounting for country fixed effects, the results in column 7 suggest negative and significant coefficient for FO (-0.151). The foreign ownership coefficient (FO) changing to negative and significant in the OLS regression with Country Fixed Effects (CFE) implies that country-specific characteristics impact the correlation between product innovation and foreign ownership. The model accounts for unobserved heterogeneity between nations that may influence foreign ownership and product innovation when employing OLS with CFE. Some of these unobserved country-level traits are cultural norms, institutional factors, or regulatory environments that are different based on a country and influence how foreign ownership impacts innovation. On average, higher amounts of foreign ownership may lead to lower levels of domestic product innovation based on specific characteristics. This is indicated by the negative and significant coefficient for FO in the OLS with CFE. This may be due to reasons such as a lack of incentives for foreign-owned enterprises to participate in innovation in such nations, or to the fact that local firms with heavy foreign ownership have limited access to resources or knowledge transfer.

Table 3: Dependent Variable - Product Innovation

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FO	1.78***	2.616***	1.277	0.019	1.157	0	-.151***
DO		1.476*	1.456	0.038	1.372	0.025	-.075***
GO		9.294***	5.307***	.286***	5.165***	.276***	.2**
Log Labor Productivity			1.11	0.017	1.193**	.024**	-0.013
Log Sales			1.108	0.011	1.058	0.007	.019**
R&D Dummy			3.742***	.271***	3.924***	.275***	.248***
Training			3.286***	.203***	3.51***	.208***	.167***
Patent			1.468***	.074***	1.526***	.076***	.139***
Horizontal (Product - Region)					.016***	-.568***	-.567***
Horizontal (Product - Sector)					.1***	-.304***	-.235**
Horizontal (R&D - Region)					49.913***	.344***	.264**
Horizontal (R&D - Sector)					14.009***	.547***	.474***
Observations	5487	5487	5079	5079	4962	4962	4962
Pseudo R^2	0.004	0.007	0.163		0.176		
R-squared				0.187		0.198	0.242
Logit	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3 and 5 are results of logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 3: Dependent Variable - Product Innovation

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FO maj	1.457***		0.994	1.232	0.027	1.097	0.006	-.077***
FO +		1.539***	1.495***	.699**	-.051**	.72**	-.041*	-0.01
GO maj			0.546	0.69	-0.062	0.67	-0.065	-0.052
GO +			2.38***	1.986**	.115**	2.197***	.127***	.154***
Log Labor Productivity				1.074	0.012	1.157*	.02*	-0.012
Log Sales				1.153**	.017*	1.098	0.012	.019**
R&D Dummy				3.744***	.271***	3.937***	.275***	.249***
Training				3.323***	.203***	3.518***	.208***	.165***
Patent				1.504***	.078***	1.551***	.079***	.139***
Horizontal (Product - Region)						.018***	-.56***	-.58***
Horizontal (Product - Sector)						.11***	-.294***	-.242**
Horizontal (R&D - Region)						57.285***	.561***	.473***
Horizontal (R&D - Sector)						12.922***	.332***	.268**
Observations	5522	5522	5522	5112	5112	4994	4994	4994
Pseudo R^2	0.002	0.004	0.006	0.164		0.177		
R-squared					0.188		0.199	0.243
Logit	YES	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3, 4 and 6 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

In Panel B of Table 3, when examining FO ^{maj}, and FO $^{+}$ separately in columns (1) and (2), results indicate that both, majority foreign control and any foreign investment led to statistically significant OR above 1. However, when examining both variables together in one regression in column (3), results point out significant OR of 1.495 for FO+ and insignificant OR of 0.994 for FO^{maj}. The insignificant OR below 1 for foreign majority ownership may imply that foreign investors who have full control over a domestic company may focus on other objectives, like increasing profits on already established products and services instead of venturing towards risky and innovative objectives. On the other hand, a firm has a foreign investor compared to when it doesn't, the odds of having a product innovation in the past 3 years are 1.495 times higher, indicating that even limited ownership can have positive effects on product innovation. Foreign investors may help a local company innovate by introducing new methods of management or insights into the market. In addition, foreign investors may be more open to funding innovative endeavors with greater long-term payoffs.

Column 3 also considers dummies for governmental ownership. It can be observed that when firm has a governmental investor compared to when it doesn't, the odds of having a product innovation are 2.38 (GO^{+}) times higher. On the other hand, GO ^{maj} of 0.546 indicates having firms' majority stake owned by state is associated with lower odds of having a product innovation. These results for GO^{+} and GO ^{maj} remain robust across all models including results of both, Logit and OLS regressions. One possible explanation is that in growing markets, a prevailing margin of government ownership can affect product innovation negatively,

as a result of market-driven incentives and potential bureaucratic inefficiencies, which can lead to longer decision-making processes and narrow innovation prospects. On the other hand, any amount of government involvement, irrespective of size, had the potential to positively impact product innovation as the government may provide strategic direction, financial support, and other resources, which can stimulate the innovation process and incentivize companies to take risks they may have otherwise refrained from taking without government backing. These results are in line with Chen, V. Z., Li, J., Shapiro, D. M., & Zhang, X. (2014) who find that one of the key elements influencing firm innovation is diversity of owners rather than ownership concentration. The results for foreign start getting less consistent when we add other variables to specification in columns 4 to 8. FO^{+} coefficient turns negative (below 1 in case of logit), while FO^{maj} goes negative in column 8 when country fixed effects are introduced. The rest of the variables, including control variables and variables indicating spillover have results similar to panel A. domestic companies may face harsher competition as a result of foreign firms increasing their innovation productivity and ownership in a region (Horizontal Product - Region), which may reduce their incentive to innovate. Likewise, foreign companies' product innovation in particular sectors (Horizontal Product - Sector) can have adverse effects on domestic companies within those sectors. Conversely, the substantial and positive coefficients for Horizontal (R&D - Region) and Horizontal (R&D - Sector) imply that the R&D operations by foreign companies have positive impacts on product innovation in the neighboring regions and the broader sector. This indicates that, although foreign ownership might have localized negative spillover effects, it can encourage larger scale positive spillovers via R&D initiatives.

In table 4 the dependent variable is Product (Market) Innovation. Product (Market) Innovation is a binary variable equal 1 if the company has come up with new or sufficiently advanced improvements to a product or service, which are also innovative for the company's main market. Otherwise, it assumes a value of 0. This variable provides insight into the innovation endeavors primarily geared toward seizing new market opportunities. The results for both, columns (1) and (2) in panel A are similar to those in table 3, with slightly lower OR for most variables. Moving to column (3) the OR for FO is now below 1, although still insignificant. The rest of the results in panel A are almost identical to those in table 3 with little difference in ORs and the size of coefficients. Foreign firm's product innovation spillover tends to have a negative impact on likelihood of product (market) innovation across both, regions and sectors. This is indicated by ORs of 0.023 for Horizontal (Product - Region) and 0.064 for Horizontal (Product - Sector). On the other hand, R&D spillover increases the odds of product-market innovation with Horizontal (R&D - Sector) being 12.734 and Horizontal (R&D - Region) being 35.494.

In panel B, the results for FO ^{maj}, and FO $^{+}$ remain inconsistent. On the other hand, we can now clearly observe significant and negative coefficients of governmental majority and significant positive coefficients of any governmental owner (in case of logit, GO ^{maj} <1 and GO $^{+}$>1). The results support the conclusion of Table 3, panel B, that it is possible that bureaucratic inefficiencies and lack of market-driven incentives negatively impact product innovation in majority state-owned firms while any form of government ownership positively affects product innovation, possibly due to financial support and strategic direction.

Besides that, Panel B once again emphasizes the negative impact of product innovation spillover across regions and sectors, while R&D spillover positively affects the product market innovation.

Finally, the relationship between foreign ownership and product innovation is complex and influenced by the inclusion of control variables and country-specific characteristics. While foreign ownership initially appears to have a positive relationship with both product innovation and product (market) innovation, this relationship may weaken or become negative when considering other factors that impact innovation.

Table 4: Dependent Variable - Product (Market) Innovation

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FO	1.411**	1.929**	0.973	-0.018	0.97	-0.022	-.11***
DO		1.369	1.388	0.021	1.345	0.013	-.051**
GO		7.369***	3.317*	.172**	3.369*	.167**	0.119
Log Labor Productivity			0.953	-0.003	1.006	0.001	-.019*
Log Sales			1.206**	.017**	1.166**	.015*	.02**
R&D Dummy			2.697***	.165***	2.796***	.166***	.155***
Training			3.279***	.148***	3.506***	.153***	.136***
Patent			1.734***	.094***	1.79***	.095***	.131***
Horizontal (Product - Region)					.023***	-.401***	-.334***
Horizontal (Product - Sector)					.064***	-.274***	-.21**
Horizontal (R&D - Region)					35.494***	.249**	.181*
Horizontal (R&D - Sector)					12.734**	.38***	.304***
Observations	5614	5614	5155	5155	5034	5034	5034
Pseudo R^2	0.001	0.004	0.144		0.156		
R-squared				0.135		0.143	0.162
Logit	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3 and 5 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 4: Dependent Variable - Product (Market) Innovation

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FO maj	1.191		0.902	1.246	0.023	1.178	0.011	-0.033
FO +		1.32***	1.328**	.581***	-.06***	.6***	-.049***	-0.029
GO maj			.447*	0.491	-.101*	.426*	-.12**	-.125**
GO +			3.036***	2.353***	.126***	2.774***	.146***	.166***
Log Labor Productivity				0.923	-0.006	0.979	-0.002	-.018*
Log Sales				1.252***	.021***	1.204**	.018**	.02***
R&D Dummy				2.716***	.165***	2.827***	.167***	.156***
Training				3.325***	.148***	3.537***	.153***	.135***
Patent				1.781***	.097***	1.824***	.097***	.131***
Horizontal (Product - Region)						.024***	-.396***	-.341***
Horizontal (Product - Sector)						.072***	-.264***	-.209**
Horizontal (R&D - Region)						40.792***	.385***	.299***
Horizontal (R&D - Sector)						12.188**	.241**	.181*
Observations	5651	5651	5651	5189	5189	5067	5067	5067
Pseudo R^2	0	0.002	0.005	0.148		0.16		
R-squared					0.137		0.146	0.164
Logit	YES	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3, 4 and 6 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

5.3 Process Innovation

In table 5 dependent variable is Process Innovation (Manufacturing). Process Innovation (Manufacturing) is a dummy variable equal 1 if, during the past three years, the company has developed any new or substantially advanced ways of manufacturing products or offering services. Otherwise, it is assigned to 0. This variable enables us to gain insight into the company's intent on improving its manufacturing processes.

In Column 1 the OR of 1.743 for FO indicates, for each one-unit increase in the FO, the odds of a firm having a process innovation are 1.743 times higher compared to the odds for a one-unit decrease in the % of foreign ownership. In other words, when the FO goes up by one unit, the odds of having manufacturing process innovation increase by a factor of 1.743. If FO goes down by one unit, the odds of innovating manufacturing process decrease by a factor of 1/1.743.

In column 2 results indicate that FO has a significant positive impact (OR of 2.107) on the likelihood of introducing manufacturing process innovation. In turn, the percentage of domestic ownership (DO) does not show a statistically significant impact on manufacturing process innovation likelihood. On the other hand, OR of 2.917 for governmental ownership (GO) suggest that with one unit increase in GO, the odds of a firm having a process innovation are 2.917 times higher compared to the odds for a one-unit decrease in the % of foreign ownership.

So far, these results indicate a similar pattern to the one observed in product innovation, with coefficients having slightly larger magnitude. Foreign and governmental owners are associated with higher likelihood of manufacturing process innovation, while domestic ownership seems not to have a significant impact in shaping innovation efforts. However, when introducing other variables in other columns, the results indicate that neither ownership structure (FO, DO, GO) nor measures of spillover have statistically significant impact on Process Innovation (Manufacturing). As an exception, in column (7), the introduction of country fixed effects has revealed significant effects for FO and Horizontal (R&D - region). Country fixed effects help to control for unobserved country-specific factors that could influence process innovation. In case of FO, country fixed effects help to reveal a coefficient of -0.115, which indicates negative correlation between percentage of foreign owned share and likelihood of manufacturing process innovation. Besides that, the significant coefficient of 0.134 for Horizontal (R&D - region) indicates that regional spillover effects of R&D activities by foreign firms have a positive relationship with likelihood of manufacturing process innovation. This suggests that when foreign firms engage in R&D activities in a particular region, it benefits local firms by fostering manufacturing process innovation.

Panel B explores the relationship between manufacturing process innovation and ownership expressed as binary variables. In Columns (1) and (2) it can be observed that when analyzed independently both, FO^{maj} and FO^{+} positively impact likelihood of manufacturing process innovation. Furthermore, column 3 reveals similar result to the one observed in columns 3 of panels B of tables 3 and 4. Significant ORs of 0.766 for FO^{maj} and 1.875 for FO^{+} strengthen the previously emphasized idea. In emerging markets like South Asia, a majority foreign ownership in a firm can reduce likelihood of manufacturing process innovation because of decision making and control related concerns. When a foreign investor holds a majority stake, it is possible that management is pushed to prioritize short-term profit maximization over manufacturing processes and infrastructure investments which usually have long-term horizon. On the other hand, any foreign ownership (FO^{+}), regardless of majority or minority is positively related to likelihood of manufacturing process innovation, possibly due to access to knowledge exchange within a company, new technologies, new practices, and access to global markets. Without majority ownership, management can

remain autonomous prioritizing long term growth, while still utilizing benefits of having foreign shareholder.

In Columns 3 to 7 where other variables are introduced the results get less consistent. Apart from FO^{maj} which remains negative (<1 in case of logit), FO^{+} now also turn negative (<1 in case of logit) and significant. A change in coefficient can be potentially explained by multicollinearity of independent variables. In terms of spillover effects, the statistically significant coefficients are revealed only when country fixed effects are introduced in Column 5. Horizontal (Process - Region) is negative (-0.211) and unlike Panel A statistically significant. Foreign firms' manufacturing innovation regional spillover can be negatively correlated to local firms' likelihood of manufacturing process innovation in South Asian emerging markets due to various reasons. First, when foreign owned enterprises introduce advanced manufacturing related technologies and processes in the region, local firms may find it complicated to keep up with the pace of innovation, leading to a widening technological gap. Second, the presence of foreign owned firms can result in increased competition, putting pressure on local firms to cut costs rather than improving manufacturing processes. Finally, manufacturing processes are unique for most of the firms, thus ability to absorb or transfer foreign methods and technologies might be challenging, which in conjunction with previously mentioned factors can reduce propensity to innovate for local firm.

Labor productivity being negative and significant in all column/panels of table 5 may indicate that higher labor productivity might reduce the need for process innovation. Firms with high labor productivity may already be operating efficiently, leading to a lower emphasis on manufacturing improvements. Contrary, log sales coefficients are always positive and significant.

Finally for Panels A and B of table 5 once again emphasize positive correlation of innovation with amount of R&D, Training and Patents of firms.

Table 5: Dependent Variable - Process Innovation (Manufacturing)

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FO	1.743***	2.107***	0.919	-0.024	0.808	-0.042	-.115***
DO		1.213	1.329	0.032	1.298	0.029	-0.011
GO		2.917**	0.95	-0.014	1.024	-0.006	-0.091
Log Labor Productivity			.823**	-.027**	.811**	-.03**	-.049***
Log Sales			1.274***	.034***	1.279***	.035***	.044***
R&D Dummy			4.558***	.318***	4.599***	.319***	.287***
Training			3.507***	.229***	3.392***	.223***	.195***
Patent			2.341***	.168***	2.271***	.163***	.199***
Horizontal (Process - Region)					2.64	0.134	-0.204
Horizontal (Process - Sector)					1.017	0.011	-0.028
Horizontal (R&D - Region)					1.045	-0.01	0.063
Horizontal (R&D - Sector)					1.006	0.005	.134*
Observations	5496	5496	5092	5092	4977	4977	4977
Pseudo R^2	0.003	0.004	0.202		0.202		
R-squared				0.245		0.244	0.263
Logit	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3 and 5 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 5: Dependent Variable - Process Innovation (Manufacturing)

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FO ^{maj}	1.325**		.766*	0.855	-0.027	0.862	-0.026	-.069**
FO $^{+}$		1.646***	1.875***	0.83	-0.025	.766*	-.036*	-0.021
GO ^{maj}			.434**	0.507	-0.089	0.516	-0.084	-0.036
GO $^{+}$			1.723**	1.247	0.034	1.327	0.042	0.023
Log Labor Productivity				.827**	-.027**	.813**	-.029**	-.046***
Log Sales				1.276***	.034***	1.283***	.035***	.041***
R&D Dummy				4.537***	.316***	4.578***	.318***	.287***
Training				3.536***	.229***	3.414***	.223***	.196***
Patent				2.331***	.167***	2.279***	.163***	.198***
Horizontal (Process - Region)						2.443	0.123	-.211*
Horizontal (Process - Sector)						1.03	0.01	-0.04
Horizontal (R&D - Region)						1.148	0.017	.132*
Horizontal (R&D - Sector)						0.951	-0.015	0.063
Observations	5530	5530	5530	5124	5124	5008	5008	5008
Pseudo R^2	0.001	0.006	0.007	0.202		0.202		
R-squared					0.244		0.244	0.262
Logit	YES	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3, 4 and 6 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 6 explores Process Innovation (Logistics and Distribution) as dependent variable. In case the firm has developed any new or noticeably improved methods of logistics, delivery, or distribution, this binary variable assumes the value of 1. Otherwise, its value is at 0. This variable enables us to gain insight into the company's innovation endeavors in terms of logistics and distribution operations.

Examining columns 1 and 2 the OR for FO (1.486 and 1.398) are smaller than in case of process innovation (manufacturing), indicating lower impact of foreign ownership on odds of innovations in logistics and distribution. Moreover, when other variables are introduced, FO turns negative (<1 in case of logit) and statistically significant across columns 3 to 7 with higher magnitude than observed for manufacturing process innovation in table 5. For instance, OR of 0.529 indicates that having a foreign investor is associated with lower odds of having innovation in logistics and distribution. In other words, firms with foreign investors are 0.529 times less likely to have had a process innovation in the past 3 years compared to firms without foreign investors. A similar pattern is observed in Panel B where FO^{maj} and FO^{+} are negative across all columns where additional control variables are introduced. Theoretically, this can be explained with an assumption that firms with higher foreign ownership might prioritize cost-cutting measures or focus on short-term profit maximization rather than focusing on long horizon investments in logistics and distribution. Besides that, it is possible that firms in these markets focus on the manufacturing side of the product chain, while logistics and distribution is outsourced to large multinationals.

On the other hand, governmental ownership keeps it already established in previous tables pattern. The OR is 3.495 in column (2), panel A, suggesting that firms with higher governmental ownership have association with higher odds of process innovation in logistics and distribution. In a comparison with manufacturing process innovation, the effect has lower magnitude. Moreover, when other variables are introduced GO in panel A and GO^{maj} and GO^{+} in panel B are insignificant.

Horizontal (Process - Region), Horizontal (Process - Sector), Horizontal (R&D - Sector) and Horizontal (R&D - Region) are statistically insignificant across all panels indicating no evidence of spillover impact on logistics and manufacturing distribution.

Log Sales, R&D Dummy, Training and Patent coefficients are similar to those observed in table 5, being large and statistically significant. Finally, Log labor productivity of 0.861 in column 3 implies that higher labor productivity may be associated with a reduced odds of process innovation in logistics and distribution.

Table 6: Dependent Variable - Process Innovation (Logistics and Distribution)

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FO	1.486***	1.398	.567**	-.083**	.529**	-.092***	-.082**
DO		0.932	1.106	0.007	1.08	0.004	0.022
GO		3.495**	1.862	0.111	1.942	0.114	0.059
Log Labor Productivity			.861*	-.019*	.845**	-.021*	-.024**
Log Sales			1.294***	.032***	1.3***	.033***	.035***
R&D Dummy			3.001***	.216***	3.061***	.219***	.198***
Training			3.206***	.189***	3.092***	.185***	.18***
Patent			3.04***	.229***	2.994***	.227***	.227***
Horizontal (Process - Region)					3.33	0.146	0.17
Horizontal (Process - Sector)					0.602	-0.063	-0.063
Horizontal (R&D - Region)					1.115	-0.052	0.01
Horizontal (R&D - Sector)					0.685	0.012	0.048
Observations	5463	5463	5047	5047	4931	4931	4931
Pseudo R^2	0.002	0.003	0.182		0.184		
R-squared				0.208		0.209	0.221
Logit	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3 and 5 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 6: Dependent Variable - Process Innovation (Logistics and Distribution)

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FO ^{maj}	1.023		.501***	.475***	-.106***	.494***	-.101***	-.099***
FO $^{+}$		1.624***	2.205***	0.965	0.002	0.905	-0.007	-0.011
GO ^{maj}			0.616	0.769	-0.023	0.785	-0.017	0.033
GO $^{+}$			1.652*	1.268	0.036	1.332	0.041	0
Log Labor Productivity				.864*	-.018*	.847*	-.021*	-.024**
Log Sales				1.298***	.032***	1.305***	.033***	.035***
R&D Dummy				3.029***	.217***	3.085***	.22***	.198***
Training				3.194***	.187***	3.077***	.183***	.178***
Patent				2.959***	.224***	2.939***	.223***	.225***
Horizontal (Process - Region)						3.01	0.135	0.14
Horizontal (Process - Sector)						0.609	-0.063	-0.062
Horizontal (R&D - Region)						1.26	0.025	0.069
Horizontal (R&D - Sector)						0.666	-0.055	0.006
Observations	5496	5496	5496	5078	5078	4961	4961	4961
Pseudo R^2	0	0.005	0.009	0.184		0.185		
R-squared					0.209		0.21	0.221
Logit	YES	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3, 4 and 6 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 7 presents the results using process innovation (supporting activities) as dependent variable. If, during the past three years, the company has come up with new or much more advanced supporting activities for operations, like accounting, computing, or purchasing; or processes, such as maintenance systems, the binary variable is assigned a value of 1. If not, the value for the variable is set to 0. Examining this variable allows to explore the company's efforts to improve its supporting activities.

The coefficients of FO in panel A replicate the pattern of FO in tables 5 and 6 with negative amplitude of coefficients being even larger (coefficients being <1 and smaller in case of logit) in case of columns 3 to 7 compared to previous observations. Other coefficients also remain robust with one major exception.

The biggest difference of process innovation for supporting activities compared to previous process innovation measures is large and significant odds ratio of *Horizontal (Process - Region)* of 4.681 for logit (column 5) and 0.207 for OLS (column 6) respectively. In panel B the effect is even larger. Considering that the coefficients for *Horizontal (Process - Region)* were also positive but not significant in case of manufacturing and logistics innovations, the difference can be attributed to knowledge absorptive capacities of local firms, skewed towards specific processes. It's possible that local firms in southern Asian emerging markets are better equipped to absorb and implement foreign process innovations related to supporting activities, leading to a more positive correlation in this case. However, they may face challenges in adopting complex manufacturing or logistics-related process innovations, resulting in a weaker correlation.

On the other hand, we can also observe that coefficients for R&D regional spillover unlike those in tables 5 and 6 are negative (<1 for logit) in table 7, although not significant. One possible explanation for the negative impact of foreign R&D spillover on innovation in supporting activities can be attributed to substitution effects and potential competition. When foreign innovations encourage developments of local manufacturing and logistics capabilities of firms, domestic firms might prioritize adopting these improvements, diverting resources away from investments in supporting activities. In turn, in case of innovations related to manufacturing and logistics the benefit of R&D spillover can be attributed to direct alignment with advancements in those sectors, leading to improved efficiencies and competitiveness. Besides that, in case of supporting activities, transfer of knowledge may be not as straightforward as in case of logistics and manufacturing, since supporting activities are context-dependent and most of the time unique for each firm.

Table 7: Dependent Variable - Process Innovation (Supporting Activities)

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FO	1.555***	1.057	.323***	-.162***	.318***	-.167***	-.165***
DO		.664***	.636**	-.062**	.644**	-.061**	-0.047
GO		2	0.53	-0.078	0.575	-0.07	-0.137
Log Labor Productivity			.797***	-.032***	.784***	-.034***	-.041***
Log Sales			1.412***	.049***	1.428***	.05***	.054***
R&D Dummy			4.297***	.297***	4.292***	.296***	.269***
Training			4.026***	.257***	3.918***	.254***	.244***
Patent			2.637***	.19***	2.517***	.182***	.182***
Horizontal (Process - Region)					4.681**	.207*	0.148
Horizontal (Process - Sector)					0.593	-0.065	-0.079
Horizontal (R&D - Region)					0.631	-0.039	0.026
Horizontal (R&D - Sector)					0.81	-0.054	0.044
Observations	5516	5516	5098	5098	4980	4980	4980
Pseudo R^2	0.002	0.004	0.224		0.223		
R-squared				0.27		0.269	0.284
Logit	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3 and 5 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 7: Dependent Variable - Process Innovation (Supporting Activities)

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FO^{maj}	1.129		.575***	.551***	-.09***	.606**	-.078***	-.074***
FO^{+}		1.65***	2.134***	0.892	-0.014	0.816	-0.027	-0.034
GO^{maj}			0.555	0.655	-0.037	0.657	-0.035	0.025
GO^{+}			1.53*	0.972	-0.006	1.015	-0.001	-0.054
Log Labor Productivity				.792***	-.033***	.774***	-.036***	-.041***
Log Sales				1.424***	.049***	1.449***	.052***	.055***
R&D Dummy				4.301***	.297***	4.291***	.296***	.269***
Training				3.935***	.252***	3.828***	.249***	.241***
Patent				2.664***	.191***	2.565***	.185***	.183***
Horizontal (Process - Region)						5.019**	.219**	0.149
Horizontal (Process - Sector)						0.571	-0.071	-0.083
Horizontal (R&D - Region)						0.571	-0.07	0.031
Horizontal (R&D - Sector)						0.784	-0.043	0.024
Observations	5550	5550	5550	5130	5130	5011	5011	5011
Pseudo R^2	0	0.006	0.009	0.224		0.223		
R-squared					0.27		0.268	0.284
Logit	YES	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3, 4 and 6 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

5.4 Other measures of innovation

In this section impact of foreign ownership and foreign R&D spillover on firm innovation is examined using R&D, patents and training as measures of innovation.

In Table 8, R&D dummy is used as a measure of innovation. In case of R&D dummy, if the company made expenditures for formal research and development in the past three years, the value of this binary variable is set to 1, otherwise it is 0. This variable allows us to identify R&D investment presence in the company's activities. In Panel A, column (1) statistically significant at 1% FO OR of 2.688 represents the change in odds of a firm having a R&D for a one-unit change in the percentage of foreign ownership. With an OR of 2.688, for each one-unit increase in the FO, the odds of a firm having a product innovation are 2.688 times higher compared to the odds for a one-unit decrease in the % of foreign ownership. The effect is larger compared to FO impact on product and process innovation. When other variables of ownership are introduced in column (2) FO remains robust with significant OR of 2.656. Additionally, GO is large and statistically significant. Moving on when other variables introduced in columns 3 to 7 neither of ownership variables is statistically significant, except for small but positive FO in column 4. Table 8 reveals odds ratio of 2.595 for Horizontal (R&D - Region) in column 5 (logit) and positive coefficients in column 6 and 7 (although significant only in panel B). Foreign R&D spillover in regions increases R&D in firms due to knowledge transfer, technological upgrading, and inspiration from successful foreign innovations. The presence of foreign companies also boosts competition, leading local firms to invest in R&D to stay competitive. Also, collaboration opportunities and access to foreign markets can further incentivize R&D investment. The results for Horizontal (R&D - Sector) are less consistent although coefficients are positive and statistically significant in column 6 and 7 of panel B.

In panel B, FO^{maj} and FO^{+} show interesting results. FO^{+} has significant odds ratio above 1 across all logit models and positive and significant coefficients across OLS models. In turn, the panel B also reveals negative association of foreign majority with R&D, with coefficient being significant in column 8 with FE. These results indicate that while foreign majority doesn't have significant impact on probability of firm implementing R&D, just any percentage foreign ownership does increase the log-odds of having R&D activities. Similarly, foreign presence in regions also positively impacts likelihood of R&D. There are a number of reasons why R&D in Asia's emerging markets could potentially benefit from foreign presence. First, having a foreign investor on board can make it easier for local businesses to have access to cutting-edge know-how and utilize research and development. Second, domestic companies are encouraged to invest in R&D to stay up with market trends and developments which occur due to the presence of successful international inventors who boost the competition in regions. Thirdly, local enterprises are pushed to innovate and differentiate their products through R&D as a result of greater rivalry from overseas

corporations. Opportunities for local and international businesses to work together promote the exchange of information and the creation of synergies can be considered another reason. The results of table 8 are in line with other academic literature which uses R&D as a measure of innovation. For instance, Liu, Q. (2023) find that that the policy of relaxing the foreign equity ratio has a notable positive impact on innovation within the domestic new energy vehicle industry, regardless of whether innovation is assessed through R&D input or R&D output measures.

Table 8: R&D as an indicator of innovation

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FO	2.688***	2.656***	1.415	.06*	1.321	0.054	0.013
DO		0.978	1.042	0.001	0.995	-0.006	0
GO		4.713***	1.242	0.053	1.201	0.045	-0.021
Log Labor Productivity			.468***	-.101***	.465***	-.102***	-.114***
Log Sales			2.744***	.133***	2.719***	.132***	.133***
Horizontal (R&D - Region)					2.595**	0.005	0.051
Horizontal (R&D - Sector)					1.228	.116***	.108**
Observations	5498	5498	5268	5268	5145	5145	5145
Pseudo R^2	0.011	0.013	0.078		0.08		
R-squared				0.07		0.072	0.119
Logit	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3 and 5 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 8: R&D as an indicator of innovation

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FO ^{maj}	1.968***		0.84	0.868	-0.029	0.852	-0.03	-.057**
FO $^{+}$		2.425***	2.627***	1.474***	.073***	1.466***	.074***	.065***
GO ^{maj}			0.547	0.763	-0.034	0.838	-0.018	0.076
GO $^{+}$			1.6	1.052	0.005	1.015	-0.003	-0.053
Log Labor Productivity				.474***	-.098***	.471***	-.1***	-.112***
Log Sales				2.694***	.129***	2.674***	.129***	.128***
Horizontal (R&D - Region)						2.651***	.12***	.109**
Horizontal (R&D - Sector)						1.156	-0.006	0.04
Observations	5534	5534	5534	5303	5303	5179	5179	5179
Pseudo R^2	0.006	0.018	0.019	0.081		0.083		
R-squared					0.072		0.075	0.121
Logit	YES	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3, 4 and 6 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 9 utilizes training dummy as an indicator of innovation. Training is a dummy variable equal 1if in the past three years, the company engaged in formal training activities for its employees for the introduction and development of new or more advanced products, services, or processes, otherwise to 0. This variable emphasizes the impact of training in fostering innovation.

In panel A foreign equity tends to show a positive and statistically significant impact on likelihood of training. However, considering that all three, FO, DO and GO have large and significant ORs and coefficients, these results could be rather attributed to data imperfection. On the other hand, in column (3) Horizontal (R&D - Region) has a significant OR of 7.067. Thus, the impact of foreign R&D regional spillover has even larger impact on odds of training than on R&D activities. The presence of foreign companies in a region can potentially boost a competitive environment, prompting local firms to invest more in training to remain competitive. Besides that, collaboration opportunities with foreign firms may create joint training programs and knowledge-sharing initiatives that further boost the training effectiveness for local firms.

Panel B which considers ownership dummies indicate similar results to those in table 8. Reginal R&D spillover remains robust while magnitude of FO^{+} which additionally supports arguments made previously.

Table 9: Training as an indicator of innovation

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FO	3.475***	5.813***	3.495***	.225***	2.647***	.174***	0.058
DO		1.691***	1.996***	.094***	1.744***	.07**	0.049
GO		9.295***	2.997*	.2*	2.848*	.186*	.189*
Log Labor Productivity			.526***	-.12***	.525***	-.12***	-.152***
Log Sales			2.788***	.191***	2.743***	.187***	.196***
Horizontal (R&D - Region)					7.067***	-0.029	-.118*
Horizontal (R&D - Sector)					0.943	.346***	.204***
Observations	5549	5549	5317	5317	5189	5189	5189
Pseudo R^2	0.019	0.022	0.1		0.104		
R-squared				0.116		0.121	0.191
Logit	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3 and 5 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 9: Training as an indicator of innovation

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FO ^{maj}	2.406***		0.979	1.028	0.005	0.943	-0.01	-.084***
FO $^{+}$		2.684***	2.657***	1.52***	.095***	1.438***	.084***	.074***
GO ^{maj}			0.689	0.917	-0.022	1.039	0.003	0.094
GO $^{+}$			1.812**	1.346	0.064	1.456	0.077	0.066
Log Labor Productivity				.545***	-.114***	.546***	-.114***	-.146***
Log Sales				2.684***	.185***	2.633***	.18***	.188***
Horizontal (R&D - Region)						8.012***	.37***	.22***
Horizontal (R&D - Sector)						1.044	-0.012	-0.109
Observations	5585	5585	5585	5352	5352	5223	5223	5223
Pseudo R^2	0.01	0.024	0.025	0.097		0.103		
R-squared					0.114		0.12	0.19
Logit	YES	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3, 4 and 6 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Finally, Table 10 uses patents dummy as an indicator of innovation. Patent is equal 1 if in the past three years, the company licensed or purchased any patented or non-patented knowledge or inventions for the development of a product or a process, otherwise to 0. This variable provides insight into the innovation process' utilization of external knowledge and technology.

Patents are widely used as a measure of firm innovation in academic literature. For instance, Gao, R., & Sammartino, A. (2022) using panel data on Chinese manufacturing firms, found that industry-level foreign direct investment (FDI) intensity resulted in an increase in the total number of patent applications by local firms. However, a significant observation was that this rise in FDI intensity was linked to a decrease in the proportion of invention patents relative to the overall number of patent applications filed by these firms.

In Table 10, panel A show inconsistent results. FO OR goes from significant 2.611 to 0.457 when other factors introduced. Negative coefficients in OLS further support these results. Going to ownership dummies we can now clearly observe negative impact of foreign majority (FO^{maj}), while FO^{+} being significant and positive (>1 for logit) across columns 3 to 8.

One possible explanation is that majority equity ownership by foreign investors leads to short-term profits preference of the management. This can be the case in case of LBOs. Besides that, it is possible that if the foreign owner is a large multinational, patents are mostly recorded at the mother company while local subsidiary remains without any records of patent registration. On the other hand, when just any percentage of foreign equity is present, it may incentivize patents due to knowledge spillovers. This argument is supported by results for Horizontal (R&D - Region) (OR of 4 and 4.454 in panels A and B respectively).

Table 10: Patent as an indicator of innovation

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FO	2.611***	1.248	.539**	-.047*	.457***	-.063**	0.005
DO		.452***	.475***	-.074***	.432***	-.083***	-0.025
GO		2.034	0.476	-0.053	0.411	-0.069	-0.015
Log Labor Productivity			.275***	-.136***	.28***	-.133***	-.119***
Log Sales			3.609***	.132***	3.612***	.131***	.128***
Horizontal (R&D - Region)					4.454***	-.097*	-.136***
Horizontal (R&D - Sector)					0.481	.138***	.183***
Observations	5491	5491	5261	5261	5135	5135	5135
Pseudo R^2	0.011	0.016	0.105		0.108		
R-squared				0.078		0.08	0.116
Logit	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3 and 5 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

Table 10: Patent as an indicator of innovation

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FO ^{maj}	1.41**		.343***	.329***	-.179***	.317***	-.181***	-.142***
FO $^{+}$		3.256***	5.049***	2.703***	.168***	2.629***	.165***	.138***
GO ^{maj}			0.728	0.928	0.008	0.983	0.023	0.035
GO $^{+}$			1.636	1.173	0.013	1.162	0.01	-0.015
Log Labor Productivity				.303***	-.123***	.308***	-.121***	-.112***
Log Sales				3.243***	.118***	3.236***	.117***	.118***
Horizontal (R&D - Region)						4***	.13***	.186***
Horizontal (R&D - Sector)						0.499	-.097**	-.137***
Observations	5526	5526	5526	5295	5295	5168	5168	5168
Pseudo R^2	0.001	0.034	0.045	0.118		0.12		
R-squared					0.094		0.096	0.127
Logit	YES	YES	YES	YES	NO	YES	NO	NO
Country FE	NO	NO	NO	NO	NO	NO	NO	YES

*Columns 1,2,3, 4 and 6 are logit regressions, numbers are odd ratios (OR = exp(β)). Detailed variable description is presented in appendix 1. *** p<.01, ** p<.05, * p<.1*

6. Conclusions

The purpose of this study was to investigate the connection between ownership structure and innovation at companies operating in developing economies. It has helped shed light on how ownership structure influences the results of product and process innovation when held by foreign and governmental entities.

Regarding product innovation, the initial results indicated positive influence of foreign ownership on likelihood of innovation. However, the positive relationship fades when considering other factors and/or accounting for country-specific characteristics, suggesting that external factors may mediate the impact of foreign ownership. In turn, governmental equity showed consistently strong positive relationship with likelihood of product innovation across all models. It appeared that state-owned businesses were better able to invest in innovative projects since they had access to vast financial resources. However, bureaucratic inefficiencies and lack of market-driven incentives might have negative impacts on product innovation in cases of majority state-owned firms. The effect of international corporations on the spillover of technological advances into domestic industries was also investigated. While strong presence of foreign firms R&D activities in the regions seems to increase the likelihood of product innovation, foreign firm's product innovation spillover negatively affects the likelihood of product innovation, possibly due to increased competition.

Regarding process innovation, the results once again indicate that significant and positive impact of foreign ownership on manufacturing process innovation, logistics process innovation and supporting activities innovation, fades when accounting for other factors. Moreover, in some models the results clearly indicate negative impact on foreign ownership. On the other hand, governmental ownership didn't indicate statistically significant impact when accounting for other factors. Regarding spillover effects, a significant positive impact of foreign firm's process innovation reginal spillover can be concluded.

Higher percentages of foreign ownership were connected with higher probability of engaging in R&D, suggesting that foreign ownership had a favorable effect on R&D activities. Possibly, domestic companies were encouraged to invest in research and development by the presence of international innovators. Local businesses were pushed to invest more resources into R&D as a result of increased competition from foreign owned enterprises. Besides R&D, higher percentages of foreign equity are associated with great probability of firms issuing/registering patents and performing employee training. It is also worth noting that while any percentage of foreign share positively impacts innovation, in most cases foreign majority tend to decrease log odd of firm performing innovative activities mentioned above. This supports the argument that in ownership structure diversity is more beneficial than concentration.

Overall, external spillover effects and country-specific characteristics are just two examples of the many factors that affect the relationship between ownership structure and innovation in developing economies. Understanding the dynamics of innovation in developing countries is becoming more and more relevant as these economies continue to grow and play a crucial role in the global economy. Policymakers, investors, and businesses may boost innovation efforts and fuel economic growth in these regions by taking into account the varied implications of ownership arrangements and foreign R&D spillover.

There are still avenues for further investigation. More nuanced insights may be gleaned from investigating how various forms of foreign and government ownership affect innovation in selected sectors and geographical areas. To further our comprehension of this multifaceted phenomenon, we should look into how institutional structures and regulatory settings affect the connection between ownership structure and innovation. Besides, since World Bank is still conducting enterprise surveys, future releases of new data may give an opportunity to explore the relationship between ownership structure and innovation in the context of panel data and more advanced estimation strategies.

Appendices

Appendix 1 - Variable description

Innovation

- Product Innovation: In case the company has implemented new or substantially improved products or services in the past three years, this binary variable assumes a value of 1. If not, then this value is set to 0. This variable allows us to evaluate the extent to which firms innovate their products during the specified time period.
- Product (Market) Innovation: In case the company has come up with new or sufficiently advanced improvements to a product or service, which are also innovative for the company's main market, this binary variable takes a value of 1. Otherwise, it assumes a value of 0. This variable provides insight into the innovation endeavors primarily geared toward seizing new market opportunities.
- Process Innovation (Manufacturing): If, during the past three years, the company has developed any new or substantially advanced ways of manufacturing products or offering services, then the value of this binary variable is set to 1. Otherwise, it is assigned to 0. This variable enables us to gain insight into the company's intent on improving its manufacturing processes.
- Process Innovation (Logistics and Distribution): In case the firm has developed any new or noticeably improved methods of logistics, delivery, or distribution, this binary variable assumes the value of 1. Otherwise, its value is at 0. This variable enables us to gain insight into the company's innovation endeavors in terms of logistics and distribution operations.

- Process Innovation (Supporting Activities): If, during the past three years, the company has come up with new or much more advanced supporting activities for operations, like accounting, computing, or purchasing; or processes, such as maintenance systems, the binary variable is assigned a value of 1. If not, the value for the variable is set to 0. Examining this variable allows us to explore the company's efforts to improve its supporting activities.

Ownership

- FO: percentage of foreign ownership
- DO: percentage pf domestic ownership
- GO: percentage of governmental ownership
- FO ^{maj} (Foreign Ownership Majority): If the company's majority ownership is allocated to foreign investors (50% or more of the ownership is from foreign investors), then the binary variable assumes the value of 1. This allows us to understand the effects on firms with majority foreign ownership in contrast to those with less foreign ownership.
- FO $^{+}$ (Foreign Ownership Positive): If any margin of the firm's ownership is held by foreign investors, then then the binary variable value is set to 1, indicating that there is more than 0% of ownership held by foreign investors. This variable will allow us to examine the effect of any amount of foreign ownership present, regardless of its size.
- GO ^{maj} (Governmental Ownership Majority): If the majority of the company is held by the government (50% or more), then the binary variable is assigned the value of 1. This metric allows us to explore the effects on firms from majority government ownership.
- GO $^{+}$ (Governmental Ownership Positive): If the company has any margin of government ownership (more than 0%), this binary variable is set to 1. This variable gives insight into the influence caused by any size of government involvement.

Spillover

- Horizontal (Product – Region): This variable measures the regional spillover effect of foreign firms' product innovation. Its value rises proportionally to both the innovation output of firms with foreign investment and the proportion of foreign ownership in these firms.

- Horizontal (Product - Sector): This variable captures the sectoral spillover effect of product innovation by foreign firms. It analyzes the impact of foreign firms' innovations in specific industries on the sector as a whole.
- Horizontal (Process – Region): This variable measures the regional spillover effect of foreign firms' process innovation. Its value rises proportionally to both the innovation output of firms with foreign investment and the proportion of foreign ownership in these firms.
- Horizontal (Process - Sector): This variable captures the sectoral spillover effect of process innovation by foreign firms. It analyzes the impact of foreign firms' innovations in specific industries on the sector as a whole.
- Horizontal (R&D - Sector): This variable concentrates on the sectoral spillover effect of foreign firms' R&D activities. It examines the impact of R&D investments in certain sectors and industries.
- Horizontal (R&D - Region): This variable examines the regional spillover effect of foreign firms' R&D activities. It examines the effects of R&D investments in certain regions on neighboring regions.

Other Variables

- Log labor productivity: These variable measures labor productivity by dividing the sales by the number of employees, and taking outcome in log. In the context of sales, it sheds light on employee productivity and efficiency.
- Log Sales: This variable is the logarithm of a company's annual sales, illuminating the company's sales performance as a whole.
- R&D dummy: If the company made expenditures for formal research and development in the past three years, the value of this binary variable is set to 1, otherwise it is 0. This variable allows us to identify R&D investment presence in the company’s activities.
- Training: In the past three years, if the company engaged in formal training activities for its employees for the introduction and development of new or more advanced products, services, or processes; then this dummy variable’s value is set to 1, otherwise to 0. This variable emphasizes the impact of training in fostering innovation.
- Patent: In the past three years, if the company licensed or purchased any patented or non-patented knowledge or inventions for the development of a product or a process, the value for this dummy variable is assigned to 1, otherwise to 0. This variable provides insight into the innovation process' utilization of external knowledge and technology.

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